Impacts of Regional Transit Infrastructure Investment on Metropolitan Atlanta:

An Examination Using the Transit Planning Board Concept 3 Vision Plan

Transit Planning Board
WORKING TOGETHER – CONNECTING OUR REGION

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Table of Contents

Summary

This document is an initial examination of the impact of major investment in regional transit infrastructure on the Atlanta region's transportation network. Concept 3 as authorized by the Transit Planning Board for public comment was used as the transit network. The initial report focuses on expected ridership and the system characteristics of:

1. Activity Center Focused
2. Create Seamless Regional Transit Network
3. Regional Mobility and Congestion Mitigation
4. Mobility for commuters, elderly, the disabled, those without cars, those that do not drive, and visitors to the region
5. Cost Benefit / Cost Effectiveness
6. Land Use Synergy

Throughout the report, a series of year 2030 estimates of various measureable impacts from the regional Travel Demand Model are presented. These estimates include all projects from the adopted ARC Envision6 Long Range Transportation Plan and include the scenarios of population and employment shifts from the Envision6 model of between 0% - 20%:

These population and employment shift scenarios were suggested by ARC staff and represent an opportunity to provide an initial test of a Concept 3 scenario while at the same time allowing a range of estimates to be developed for the impacts of Concept 3. Some of the important points to take away from this analysis of the impact of a regional transit system similar to Concept 3 on the Atlanta region are:

1. An estimated daily weekday ridership between 832,000 and 1,800,000

2. Increased transit accessibility to the major employment centers

3. Estimated value of annual congestion benefits between $340 and $736 million

4. Estimated 15 to 40 fewer annual fatalities

5. Estimated annual benefits in 2030 between $5.3 -$12 billion

6. A potential ratio of estimated annual benefits to estimated cost of Concept 3 between 2,2 and 5.0

7. Increased accessibility to major hospitals, courthouses, educational facilities, regional parks, and entertainment venues

Background

The Transit Planning Board has asked for a comprehensive examination of the impact of regional transit on Atlanta with a specific emphasis on the costs and benefits of transit. This document provides an overview of the impact of major investment in regional transit infrastructure on Atlanta through an examination of model results using the Atlanta Regional Commission Regional Travel Demand Model. Information on potential quantifiable benefits of transit projects are available from sources such as the Texas Transportation Institute's Annual Urban Mobility Report, reports from the Carl Vinson Institute at the University of Georgia and the American Automobile Association, while costs for the various projects were developed by staff using a published methodology.[1]

This report presents an overall rough estimated cost benefit analysis over a 20 year time frame for major investment in regional transit infrastructure through 2030 using Concept 3 with some limitations. These limitations are:

- Quantifiable benefits are confined to the potential congestion, safety, economic, and consumer fuel savings benefits of transit. Other quantitative benefits such as improved air quality through reduction in emissions are not included due to time and resource constraints
- Accessibility to activity centers is used as a proxy for labor market unification benefits. An estimate of this value benefit, reported to be one of the largest benefits of transit investment to the Atlanta region, is provided using historical trends from impact of the MARTA system on the Atlanta region.[2]
- Using the methodologies applied for this analysis for project level examination is cautioned for the following reasons[3]:
    - The current Origin-Destination survey used to calibrate the mode choice assignment for the RTDM was conducted in 2000-2001. This predates the introduction of a large number of new services in the region including much of the express and local bus service expansion in suburban counties
    - The absence of any existing commuter rail or light rail services in the region means that there is no local basis for the calibration of mode choice assignment to commuter rail or light rail projects in future-year scenarios
    - The RTDM treats heavy rail, light rail, and streetcar identically in terms of their perceived characteristics except for average speed

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[1] "Atlanta Transit Planning Board Project Prioritization Process," Transit Planning Board (August 6, 2007). Pg. 3
[2] Tanner, Thomas C. and Adams Jones. The Economic Impact of the Metropolitan Atlanta Rapid Transit Authority: An analysis of the impact of MARTA Operations on and around the service delivery region. Georgia Economic Modeling System, Carl Vinson Institute of Government, The University of Georgia. Athens, GA. May, 2007.
[3] Most of these challenges will be corrected through completion of the anticipated On-Board Transit Origin-Destination Survey in the 2009-2010 timeframe

Additionally, as part of the ongoing interest by ARC staff in scenario-based modeling, ARC staff used this exercise as an opportunity to test four population and employment scenarios. This was accomplished using the same transportation network – in this case the Concept 3 transit network with E6 roadway network. This allowed development of a range of impacts related to population and employment shifts on the transportation system. This report will focus on the impact of these different population and employment scenarios on the transit network.[4] The population and employment shifting methodology is described in Appendix 1.

This report is structured in the following manner:

First is a section on potential regional ridership according to the regional travel demand model. This effort is to provide a range of regional ridership figures for the investment in regional transit infrastructure. Second an analysis of the impact of accessibility to employment centers to provide a sense of the potential increase in labor market available by transit for the major employment centers. The third section presents a short analysis of the network connectivity of the Concept 3 network by examining transfers required to travel between major employment centers. The fourth section examines the impact of Concept 3 system on the surface transportation network with a focus on the value of the congestion and safety benefits. The fifth section examines how the regional transit system improves mobility for various targeted groups through an examination of how the Concept 3 network reaches regional destinations. The sixth section provides an examination of cost benefit and cost effectiveness of the Concept 3 network through an examination of the costs, the benefits of congestion relief, safety, consumer fuels savings, and economic benefits through labor market efficiencies. Cost effectiveness is examined through comparison of some of the network with national peer experiences with a focus on the high capacity rail network. The seventh section focuses on land use synergy by identifying how the Concept 3 network interacts with the Livable Centers Initiatives of the Atlanta Regional Commission. The final section draws some initial conclusions regarding what impact regional transit infrastructure investment could potentially have on the Atlanta region by 2030.

[4] This effort was undertaken as an initiative of ARC staff

Regional Ridership Estimates

To quantify the impact of regional transit infrastructure investment on the system, both current and future, an estimate of potential regional ridership is needed. The ARC regional travel demand model provides a useful tool for estimating a general range of regional ridership through an estimate of average daily weekday trips. Some of the other measures of transit performance include estimates of annual trips and annual passenger miles. These measures are used in the estimation of the value of the congestion mitigation and safety benefits of regional transit investment. Using the model output of average daily weekday trips annual trips and annual passenger miles are estimated using the following methodology.

Equation 1 is used to estimate annual ridership (trips) to compare trips on both a weekday and annual basis:

Equation 1: $AR_i = Weekday\ Unlinked\ Trips_i * (WK + 1/2Sat + 1/3Sun)$

where:
i = Mode
AR = Annual Ridership Estimate
WK = Number of day with Weekday Service in a normal year
Sat = Number of days with Saturday Service in a normal year[5]
Sun = Number of Days with Sunday service in a normal year[6]

Equation 2 is used to estimate annual passenger miles in order to estimate the distances traveled within the regional transit system. This estimate is also useful if there is any desire to estimate the potential impacts on safety through crash analysis and to estimate emissions benefits since these estimates frequently require passenger miles as an input.

Equation 2: $PM_i = AR_i * AvgTripLength_i$

where:
i = Mode
AR = Annual Ridership Estimate
PM = Estimated Annual Passenger Miles
AvgTripLength = Average Trip Length in miles

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[5] Saturday service days are assumed to be all regular Saturdays in an average year (52), plus additional days normally scheduled with Saturday service such as the day of Thanksgiving and Christmas Eve day or 54 days per year

[6] Sunday service days are assumed to be all regular Sundays in an average year (52), plus Thanksgiving, the Fourth of July, Memorial Day, Labor Day, and Christmas, or 57 days per year

Table 1 below presents the average trip length by mode. Commuter rail and express bus trips are estimated at the same lengths because of their trip type similarities. Similarly LRT, Premium BRT, and HRT trip lengths are assumed to be the same length. Streetcar, Beltline, and Local Bus trips are also considered to be the same average length given their similar nature.

Mode	Average Trip Length (miles)
HRT[7]	7.08
LRT[8]	7.08
Streetcar / Beltline[9]	4.03
Premium BRT[10]	7.08
Express Bus[11]	26.8
Local Bus[12]	4.03
Commuter Rail[13]	26.8

Table 1 – Average Trip Length by Mode for Estimation Purposes

Table 2 below provides the potential impact on average daily weekday trips, estimated annual trips, and estimated annual passenger miles for an Atlanta regional transit system using available travel demand model results provided by ARC and the equations above to estimate annual trips and annual passenger miles. The National Transit Database figures for 2005 and the model estimates for 2005 are included to illustrate how the model compares to the actual performance of the existing regional transit system.

[7] Source: MARTA 2006 NTD Report: Annual Passenger Miles HRT / Annual Passenger Trips

[8] Source: MARTA 2006 NTD Report: Annual Passenger Miles HRT / Annual Passenger Trips – Trip type for regional LRT assumed to be similar in characteristics to existing HRT trips

[9] Source: NTD 2006, Average Atlanta Regional Bus Trip Length– Trip type for streetcar assumed to be similar in characteristics to existing local bus trips

[10] Source: MARTA 2006 NTD Report: Annual Passenger Miles HRT / Annual Passenger Trips– Trip type for Arterial BRT assumed to be similar in characteristics to existing HRT trips

[11] Source: GRTA Presentation to the TPB Board, May 24, 2007

[12] Source: NTD 2006, Average Atlanta Regional Bus Trip Length

[13] Source: GRTA Presentation to the TPB Board, May 24, 2007– Trip type for commuter rail assumed to be similar in characteristics to existing express bus trips

Measure	Actual 2005[14]	2008 Model Est.	E6 2030 Est.	2030 Concept 3 Est.	Concept 3 5% Pop./ Emp. Shift	Concept 3 10% Pop./ Emp. Shift	Concept 3 15% Pop./ Emp. Shift	Concept 3 20% Pop./ Emp. Shift
Average Daily Weekday Trips	**495,730**	**434,000**	**716,000**	**832,000**	**1,017,000**	**1,226,000**	**1,464,000**	**1,800,000**
Est. Annual Trips (1,000,000)	**150**	**129**	**213**	**248**	**303**	**365**	**436**	**537**
Est. Annual Passenger Miles (1,000,000)	**811**	**758**	**1,339**	**1,589**	**1,974**	**2,421**	**2,927**	**3,643**

Table 2– Estimates of Regional Trips on a Regional Transit System

Table 2 reveals that the regional travel demand model estimate is lower than the actual performance of the system in 2005This suggests that any estimate of average weekday trips and estimates derived from average weekday trips probably represent a conservative estimate. The regional travel demand model estimates suggest that a network similar to Concept 3 would nearly double or quadruple average daily weekday boardings - depending on the shifts in population and employment. A similar outcome would be expected for annual passenger trips, but annual passenger miles might be expected to show almost a tripling to a quintupling of annual passenger miles. This reflects one desired focus of a regional transit system investment on providing alternatives for commuters, particularly those with hour or longer commutes – generally longer trips. These ranges should be considered a lower and extreme upper range for the impact on average weekday trips, annual trips, and annual passenger miles for a regional transit system investment.

Another method to estimate potential ridership of a regional transit system major investment is by using estimates of service hours provided. This method takes existing performance measures, such as trips / service hour and uses estimated additional service hours needed to estimate future operating costs and finally combines the two numbers to generate estimated ridership. Table 3 provides estimates for the original Concept 3 released for public comment in November.

[14] Source: NTD 2005 for MARTA, GRTA, CCT, GCT, City of Canton compiled by the Transit Planning Board

	Service Hours	Trips / Service Hours[15]	Est. Annual Trips	Est. Annual Passenger Miles
All Bus	4,198,000	35.05	147,139,900	593,000,000
Streetcar	242,000	67.39	16,309,405	81,000,000
LRT	220,000	67.39	14,826,732	130,000,000
Heavy Rail	82,000	86.21	7,069,220	50,000,000
Commuter Rail	65,000	47.55	3,090,597	97,000,000
Total Additional			188,435,855	951,000,000
Existing Annual[16]			152,002,392	810,800,000
Estimated Total Annual System			340,438,247	1,761,800,000

Table 3 – Estimates using Additional Service Hours

This method for estimating annual passenger trips and passenger miles generates results that fall within the upper and lower ranges of the estimated annual trips and passenger miles from the regional travel demand model. Using Equation 1, this method also estimates average daily weekday trips at approximately 1,130,000 trips / day; again a result in the mid-range of approximately 810,000 to 1,800,000 trips / day provided by the regional travel demand model.

In summary, a regional transit system similar to Concept 3 would be expected to increase regional average daily boardings to between 810,000 to 1,800,000 per day. This is dependent on shifts in population and land use along with other factors. A reasonable expectation is 1,100,000 boardings / day based upon the anticipated service to be supplied.

[15] Trips / Service hour estimated from National Transit Database – All Bus and Heavy Rail from regional Atlanta numbers, and LRT, Streetcar, and Commuter rail numbers from 2005 national averages.
[16] Source: NTD 2006 for MARTA, GRTA, CCT, GCT, City of Canton compiled by the Transit Planning Board

Activity Center Connectivity

A key characteristic of Concept 3 is "Activity Center Connectivity." Referring back to the Georgia Economic Modeling Systems report on the impact of the MARTA system on metro-Atlanta, the greatest benefit is in terms of unifying the labor market. This report estimates that the impact of the MARTA system on metropolitan Atlanta ranges between $2 - $2.5 billion annually between 2001 and 2006. For comparison the estimated annual amount needed both to operate our current regional transit system and construct and operate the Concept 3 vision is $2.4 billion in 2007 dollars. This is within the range of the economic impact of the current MARTA system. Since economic impacts of transit system investment are not explicitly captured in the regional travel demand model, one way to estimate the potential impact of the regional transit system on labor market unification is through examination of accessibility to the major employment centers. One of the important conclusions of the Georgia Economic Modeling System's report on the impact of MARTA on the Atlanta region was the value was primarily the result of labor market unification. This means that workers are able to find jobs that met their skills more easily because of MARTA and that employers are able to find employees that meet their needs raising the productivity of the Atlanta region's economy. Table 4 below presents the estimated economic impact of MARTA on the Atlanta region with the capital and operational dollars spent on the regional transit system in Atlanta from 2001 to 2006.

	2001	2002	2003	2004	2005	2006
Estimated Economic Impact of MARTA[17] (Millions $)						
	$1,333	$1,563	$1,571	$1,543	$1,589	$1,630
Total Annual Operating Costs for the Atlanta Regional Transit System (Millions $)						
	$344	$313	$337	$332	$338	$334
Total Annual Capital Costs for the Atlanta Regional Transit System (Millions $)						
	$268	$248	$255	$220	$183	$221
Total Annual Capital and Operating Costs for the Atlanta Regional Transit System (Millions $)						
	$612	$561	$592	$552	$521	$555
Ratio of Estimated Economic Impact and Total Costs						
	2.2	2.9	2.7	2.8	3.0	2.9

Table 4 – Estimated Economic Impact of MARTA and Regional Transit System Costs

[17] Tanner, Thomas C. and Adams Jones. The Economic Impact of the Metropolitan Atlanta Rapid Transit Authority: An analysis of the impact of MARTA Operations on and around the service delivery region. Georgia Economic Modeling System, Carl Vinson Institute of Government, The University of Georgia. Athens, GA. May, 2007.

[18] Source: NTD 2006 for MARTA, GRTA, CCT, GCT, City of Canton compiled by the Transit Planning Board

[19] Source: NTD 2006 for MARTA, GRTA, CCT, GCT, City of Canton compiled by the Transit Planning Board

Table 4 reveals that the estimated economic impact of the MARTA system alone exceeds the amount the Atlanta region spent through local, state, federal, passenger fares, and other revenues to operate and maintain the entire regional transit system by a ratio of between 2.2 to 3.0. As the GEMS report notes, this estimated impact does not include any benefits from safety improvement, air quality improvements or congestion relief and is primarily based upon improvements to the Atlanta region's economic productivity due to labor market unification.

Figures 1 – 8 below provide a visual representation of how the current regional rail network impacts our major employment centers and provides a visual representation of labor market unification. Figures 1 – 4 show the origins of trips to Downtown, Midtown, Buckhead, and Perimeter Center, all employment centers along the existing MARTA heavy rail lines. These figures were taken from the comments submitted by MARTA on Concept 3.[20]

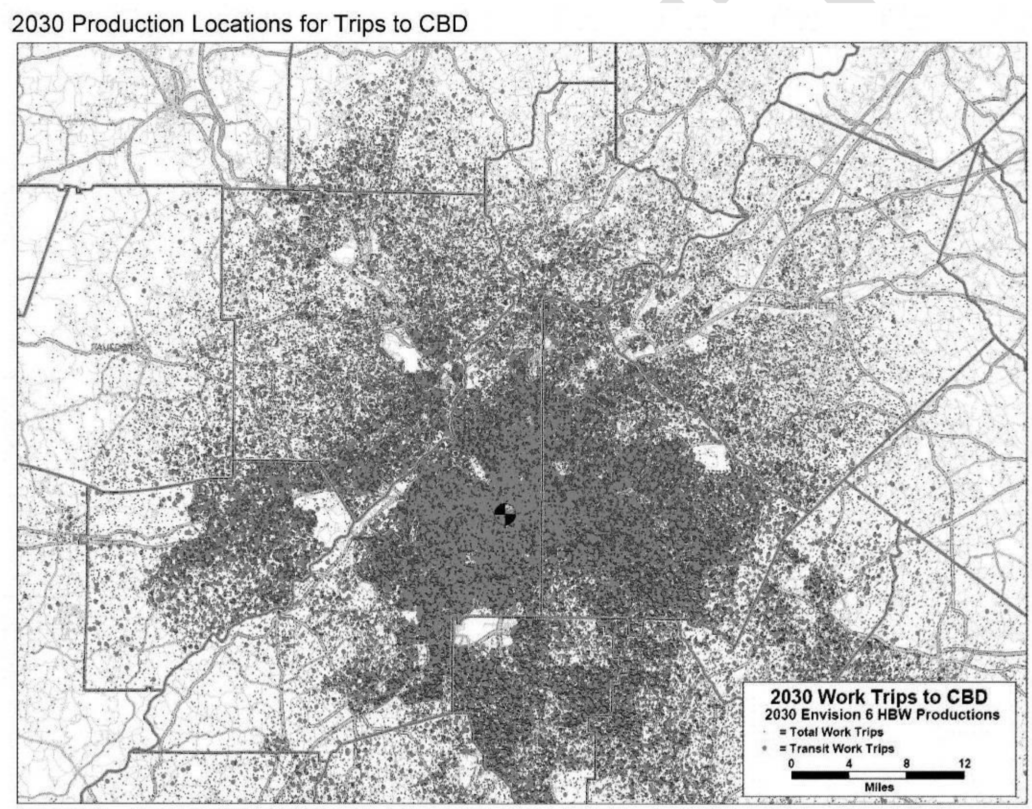

Figure 1 – Origins of Downtown Employment Trips

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[20] Move the Atlanta Region Now: TPB Concept 3 Review. Metropolitan Atlanta Rapid Transit Authority, June, 2008. Section 3 – Activity Center Trip Patters

2030 Production Locations for Trips to Midtown

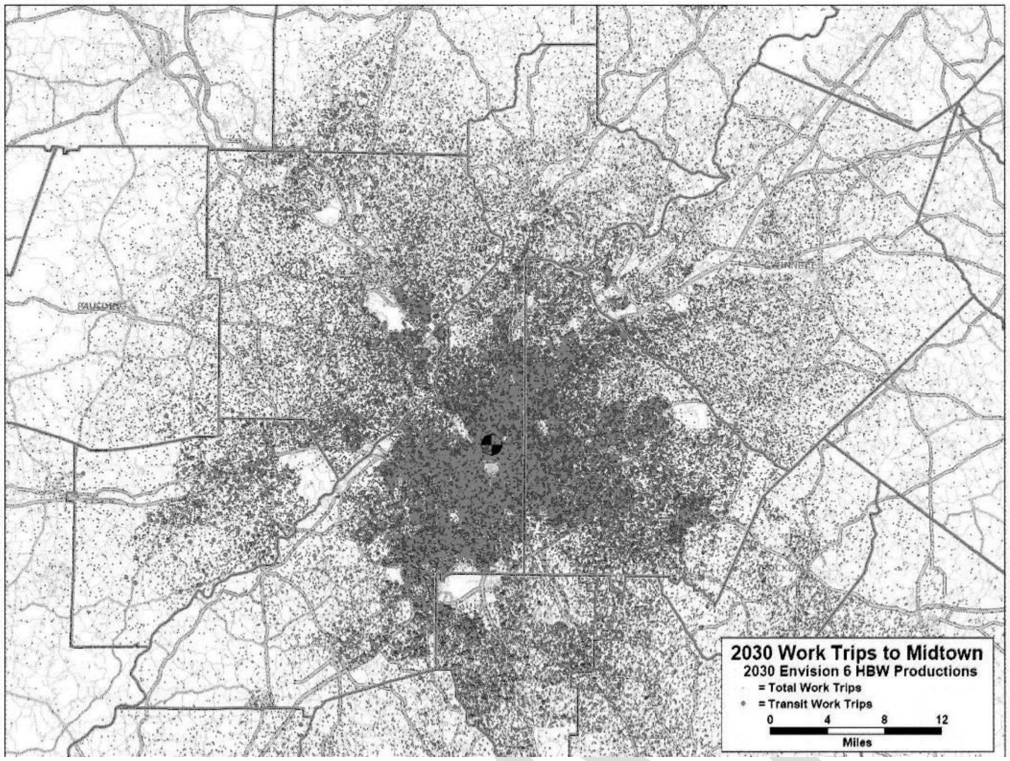

Figure 2 – Origins of Midtown Employment Trips

2030 Production Locations for Trips to Buckhead

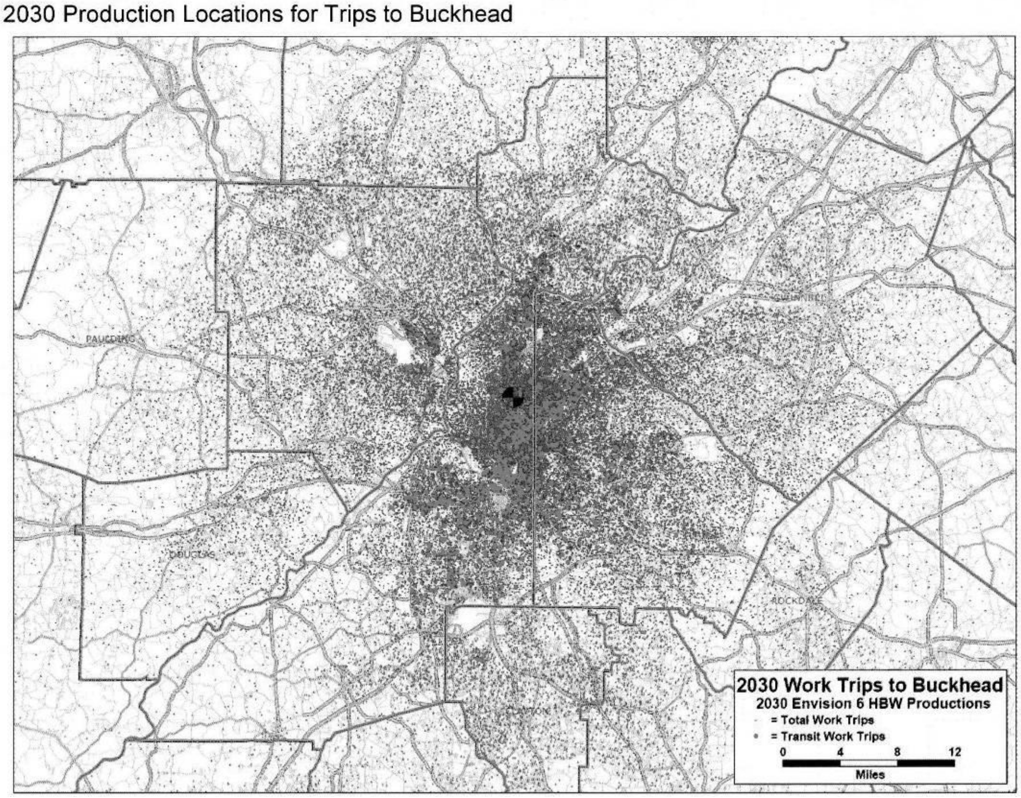

Figure 3 – Origins of Buckhead Employment Trips

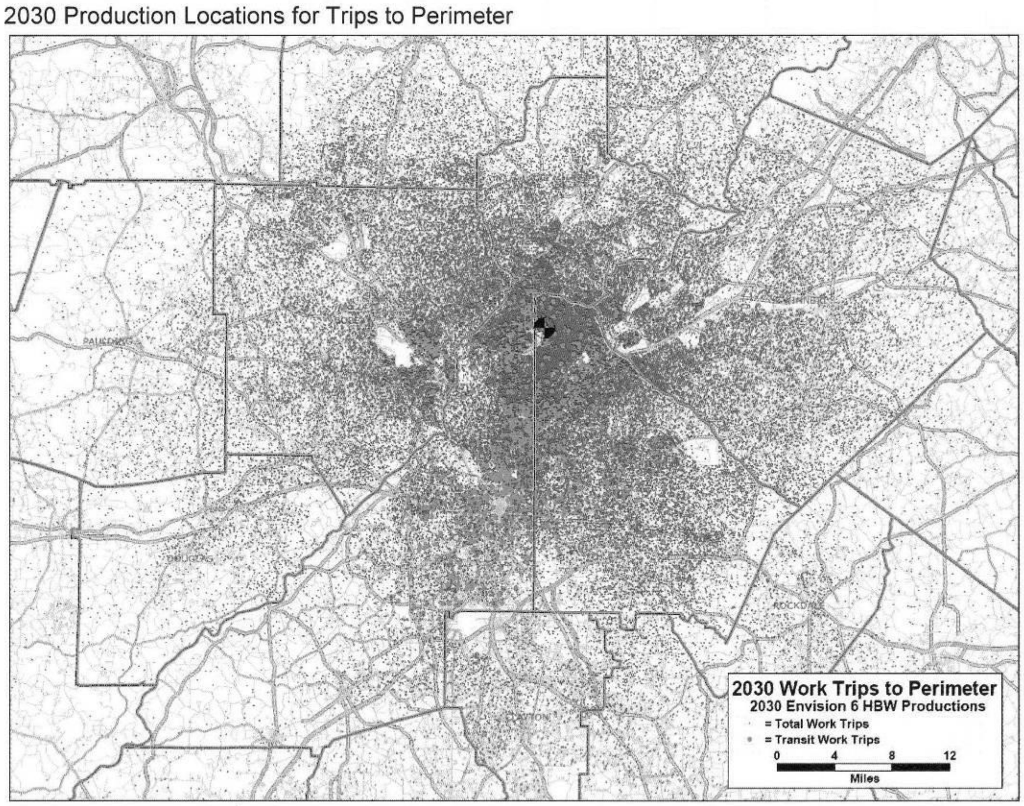

Figure 4 – Origins of Perimeter Center Employment Trips

Each of these employment centers has a nexus of strong employment trip origins centered around their main core. Additionally, noticeable on the Perimeter and Buckhead figures, are additional pockets of origins in central DeKalb, central Fulton and west Atlanta – all located along the existing MARTA rail lines. In general, these figures show that in addition to drawing strongly from the immediate area, these employment centers also draw employees from the areas of the region with strong transit access, expanding their potential employment base.

Figures 5 – 8 illustrate the work trip origins for four additional employment centers not currently connected to the regional fixed guideway system – Cumberland, Gwinnett Place, Peachtree Corners and Southlake.

2030 Production Locations for Trips to Cumberland

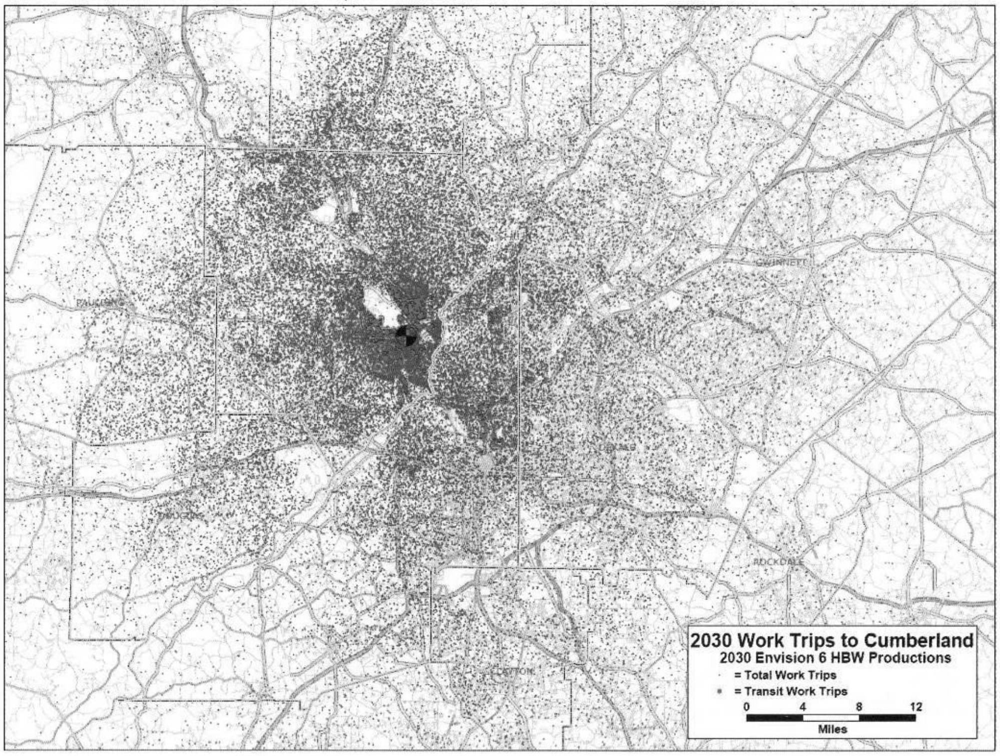

Figure 5 – Trip Origins for Cumberland

2030 Production Locations for Trips to Gwinnett Place

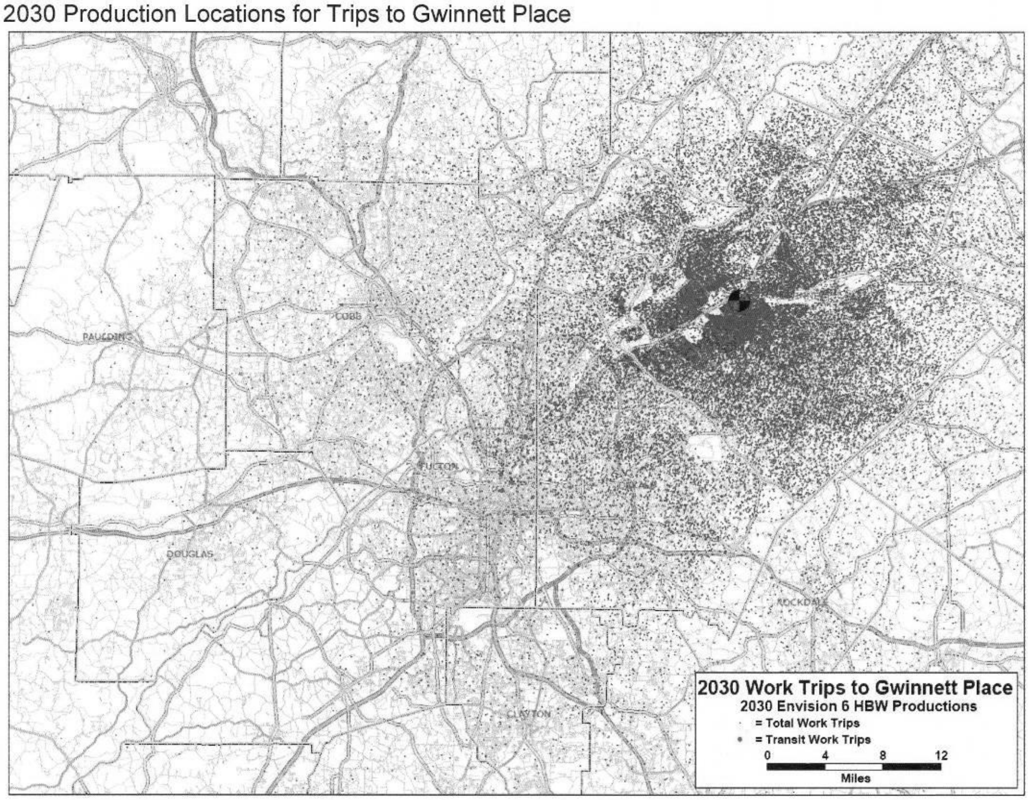

Figure 6 – Trip Origins for Gwinnett Place

2030 Production Locations for Trips to Norcross/Peachtree Corners

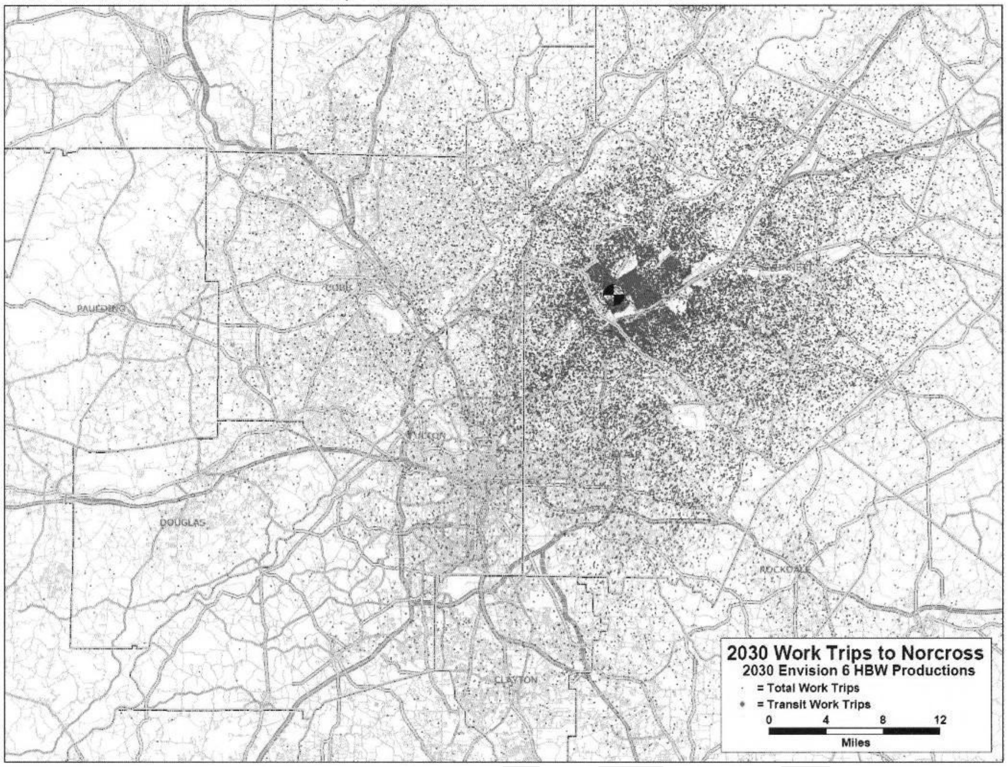

Figure 7 – Trip Origins for Peachtree Corners

2030 Production Locations for Trips to Southlake

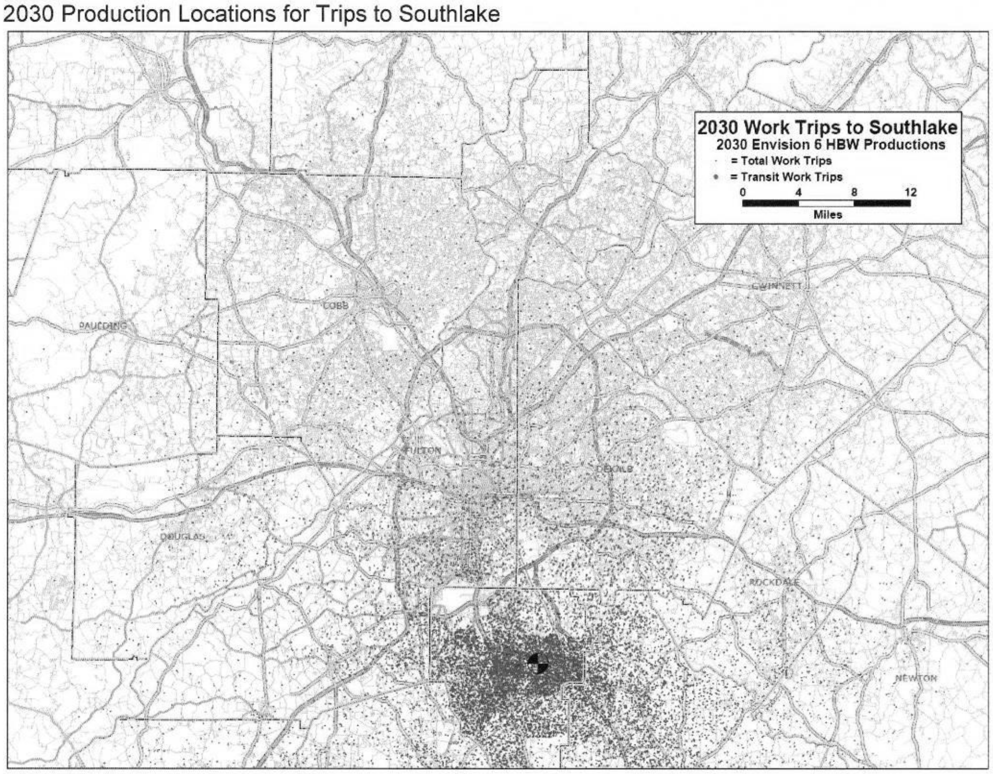

Figure 8 – Trip Origins for Southlake

In contrast the previous figures, Figures 5 – 8 shows that trip origins are only concentrated in the areas around these employment centers. This means that these major employment centers only draw the vast majority of their employees from their immediate area and are not drawing significantly from the broader region. One potential suggestion from these figures is that the regional heavy rail system allows the employment centers with direct access to draw from both their immediate surrounding area as well as areas along the heavy rail system for large number of employees, while major employment centers not connected to the heavy rail system only draw employees from their immediate surroundings.

While the regional travel demand model does not explicitly include estimates of the economic impact of transportation investments on the labor market of the region, it does provide information on household accessibility to major activity and employment centers. Using this accessibility as a proxy for labor market impact, since increased accessibility should improve labor market productivity by providing more potential employees for available jobs, it is possible to judge whether transportation investments might have a strong impact on the regional labor market. Initial results have focused on the major activity centers of Downtown, Midtown, Buckhead, Perimeter Center, and Cumberland. Table 5 below presents the number of households within 30 minutes of walk to transit in these different activity centers for the existing system, the 2030 E6, and base 2030 Concept 3 along with the different population and employment shift scenarios as prepared by ARC.

Measure	2008 Model Estimates	2030 E6	2030 Concept 3 Base	Concept 3 5% Pop./ Emp. Shift	Concept 3 10% Pop./ Emp. Shift	Concept 3 15% Pop./ Emp. Shift	Concept 3 20% Pop./ Emp. Shift
Downtown	166,416	237,096	244,546	268,866	295,081	324,718	343,747
Midtown	129,514	183,656	193,202	215,659	234,897	256,414	275,529
Buckhead	96,741	161,652	194,190	214,857	234,817	249,355	264,002
Cumberland	27,364	66,188	90,341	98,087	107,296	115,906	123,864
Perimeter Center	44,907	74,830	107,368	119,052	131,057	143,327	151,728
Airport	55,458	70,285	78,245	86,495	94,635	101,760	114,215
Town Center	1,062	26,984	19,419	21,387	24,533	26,169	28,411
Gwinnett Place	12,924	22,419	35,135	37,127	38,947	44,004	46,848
Peachtree Corners	9,944	12,092	14,516	15,967	17,593	18,873	20,658
Southlake	2,280	5,267	8,751	9,418	11,522	12,247	13,307
Fulton Industrial Boulevard	22,255	36,360	39,079	42,055	46,490	49,783	54,450
North Point	1,635	1,844	22,413	24,862	27,241	29,762	31,630

Table 5 – Households within 30 minutes by transit for activity centers according to the regional Travel Demand Model

Table 5 reveals that according to the regional travel demand model, with one exception, there is an increase in accessibility for all activity centers in terms of households within a 30 minute walk to transit. Town Center shows a loss of households within a 30-minute walk to transit. Notably the North Point area's accessibility by transit dramatically increases according to the regional travel demand model by over 1,000%.

As a proxy for a more unified labor market, the initial analysis indicates that Concept 3 would have a net positive impact on the Atlanta region through improvements in accessibility to employment opportunities.

Create Seamless Regional Transit Network

A method to measure this characteristic is to examine the number of connections, or transfers, required to reach activity centers within the potential transit network. With thirteen major activity centers identified, there are a total of seventy-eight (78) different combinations of activity center to activity center pairs. Table 6 presents the current number of transfers required to reach each activity center from a specific activity center with the current transit network and the Concept 3 network.

Number of Transfers Required to Travel Between Activity Centers	Existing System	Concept System 3
0	12	40
1	25	33
2	24	5
3	13	0
4	4	0
Total	78	78

Table 6 – Activity Center Transfer Matrix

Table 6 reveals that there are only twelve activity center pairs in the 2008 transit network that can be reached without a transfer and that there are four pairs that require four transfers. Those four are:

1. Fulton Industrial Boulevard to Peachtree Corners
2. Peachtree Corners to North Point
3. Town Center to Fulton Industrial Boulevard
4. Town Center to Peachtree Corners

The network in the Concept 3 vision plan has no activity center pair with more than two transfers. Over half of the travel between activity centers would require no transfer and only five pairs would require two transfers:

1. Fulton Industrial Boulevard to Buckhead
2. Fulton Industrial Boulevard to North Point
3. Peachtree Corners to Emory
4. Peachtree Corners to Fulton Industrial Boulevard
5. Southlake to Fulton Industrial Boulevard

What the pair-to-pair comparison reveals is that Concept 3 provides a fairly dense, interconnected network of services between the thirteen major activities centers that allows for convenient travel between them. In other words, the transit system provides a core backbone through mobility between the most important multi-use regional centers. This enables the workforce to travel effectively and efficiently between employment opportunities.

Regional Mobility and Congestion Mitigation

This section examines at a system level, the impact of the Concept 3 network on the surface transportation system of the metro Atlanta region focusing on the surface roadway network under congested conditions and safety impacts.

Surface Roadway Network

Modeling of the Concept 3 network produced some interesting results on the surface freeway and arterial network. Figures 9 – 12 provide an overview of the congestion on the surface freeway and arterial road networks all day and during the PM peak for the urban, suburban, and exurban sections of the system.

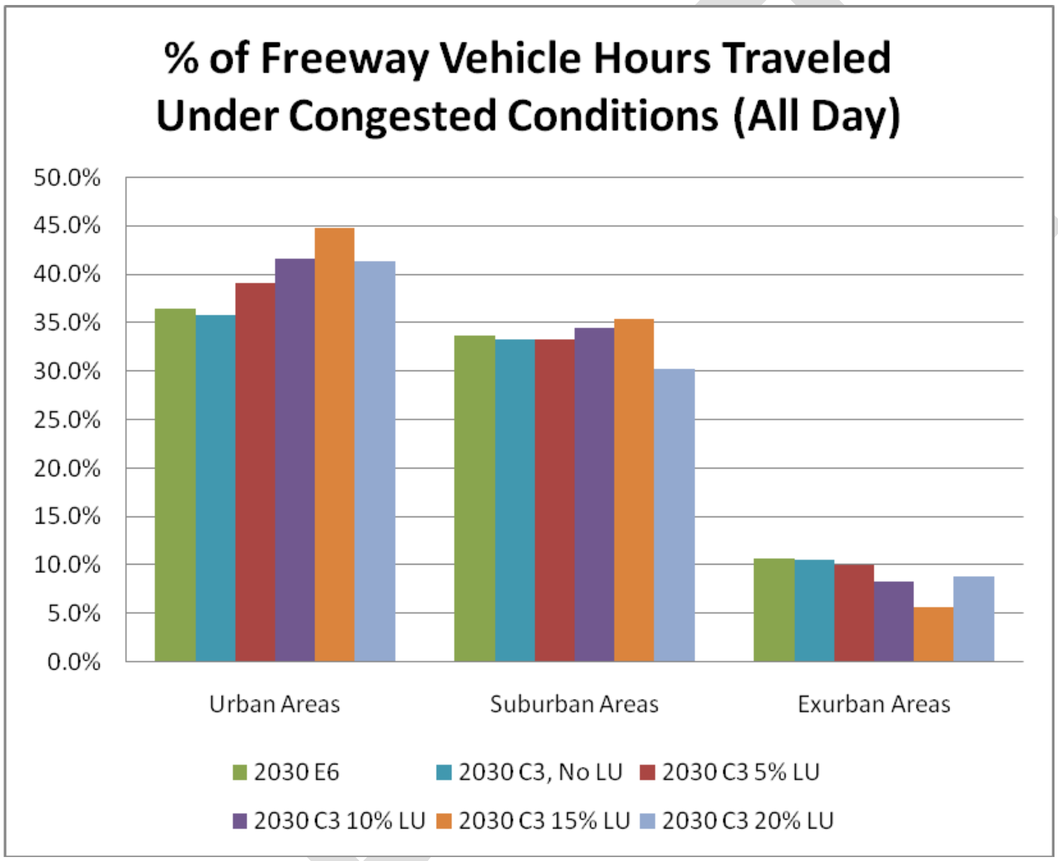

Figure 9 - % of Freeway Lane Miles Under Congestion throughout the Day

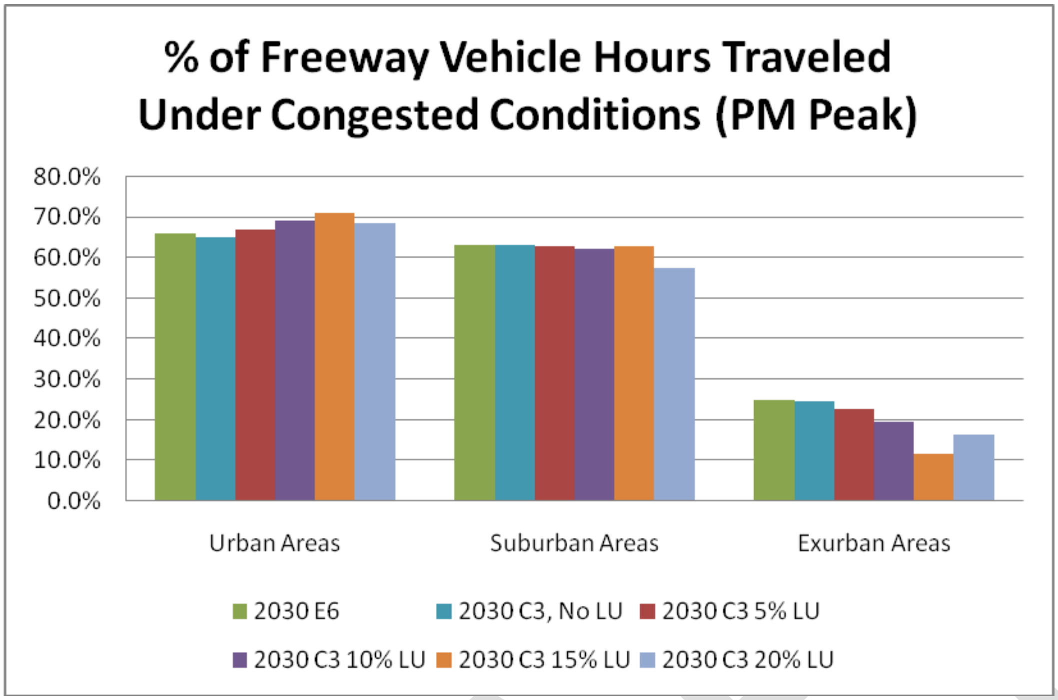

Figure 10 – Percentage of Vehicle Hours Traveled Under Congested Conditions during the PM Peak Period

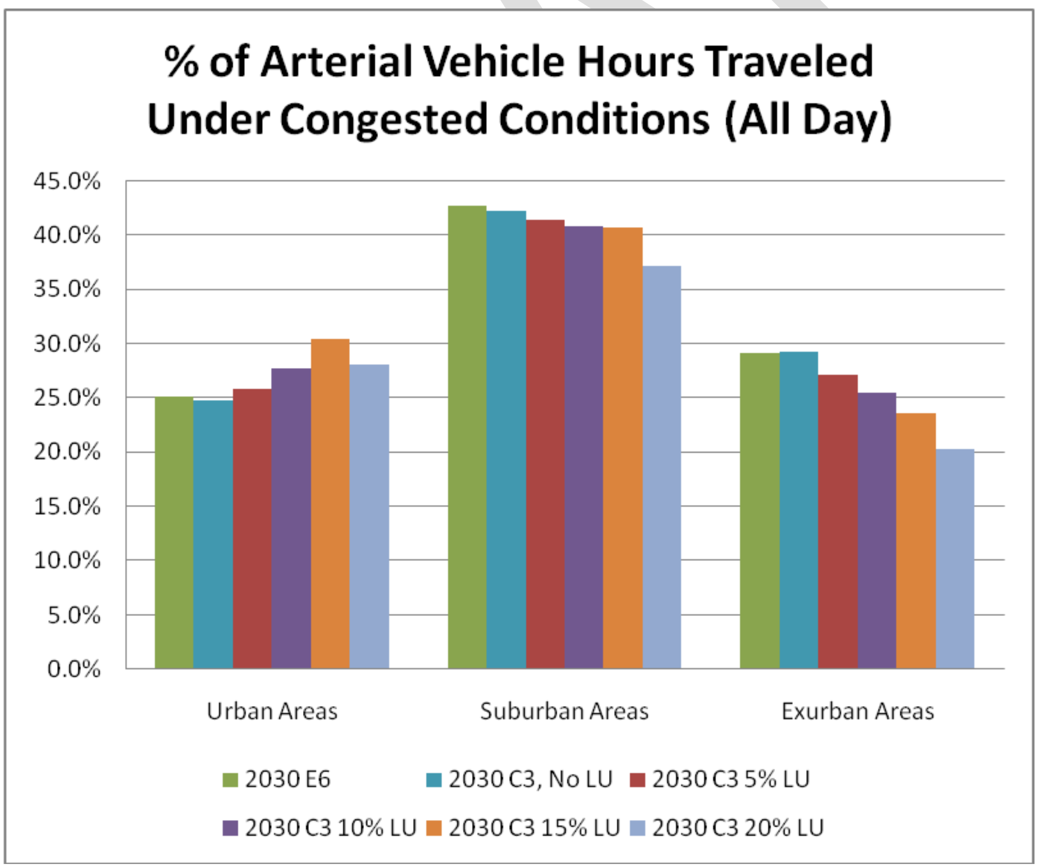

Figure 11– Percentage of Arterial Lane Miles Under Congested Conditions

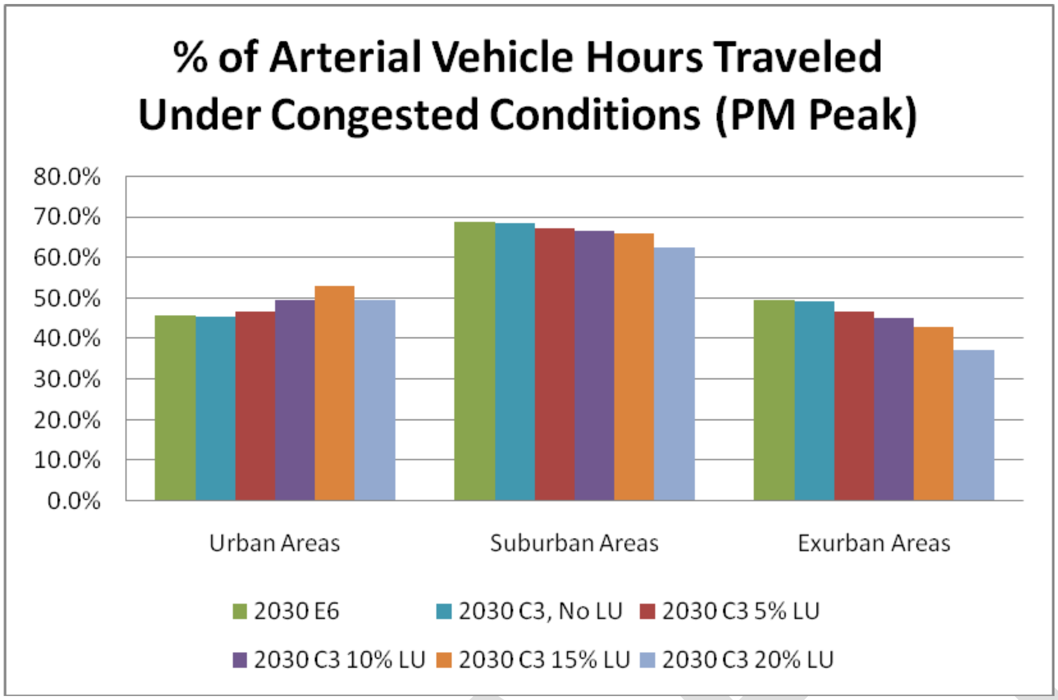

Figure 12 – Percentage of Arterial Vehicle Hours Traveled Under Congested Conditions during the PM Peak

Figures 9 – 12 reveal that while congestion may increase within the urban parts of the roadway network, the percentage of time in congestion decreases on the suburban and exurban roadway network, particularly for the arterial network. What is also interesting to note is that suburban arterials have consistently higher congestion levels than either urban or exurban arterials. Indeed, suburban arterials spend as much time under congested conditions (as a percentage of vehicle hours traveled) as urban freeways.

Measures	E6	2030 C3, No LU	2030 C3, 5% LU	2030 C3, 10% LU	2030 C3, 15% LU	2030 C3, 20% LU
Annual Travel Time (hours) / person	374.70	372.70	371.30	369.70	369.10	344.10
% of Travel Time Spent in Congestion	40.10%	39.90%	40.80%	42.10%	44.00%	42.20%
Annual Travel Time in Congestion (hours)	150.25	148.71	151.49	155.64	162.40	145.21

Table 7 – Per-capita Travel Time Measures

Table 7 reveals an interesting point – overall the Concept 3 network and the population / employment shift scenarios reveal that metro-Atlantans would spend less time traveling, but may experience a greater percentage of that time in congestion.

Overall, these measures show that there would be a reduction in travel time and in congested conditions for some parts of the freeway and arterial network in the outer lying areas. This suggests that a transit investment decision makers need to consider the tradeoff between less congestion in the exurban and suburban network and more congestion on the urban surface transportation network.

Safety

As part of the process for evaluating *Envision6*, the currently adopted Regional Transportation Plan, the Atlanta Regional Commission created a methodology for determining the impact of future transit projects on roadway congestion.[21] The rationale for examining the safety impacts of a regional transit system investment is that there are significant differences in fatality and injury rates between modes. Table 8 below provides an overview of the different injury and fatality rates for different modes.

Mode	Crashes/ 100 million Passenger Miles[22]	Fatalities / 100 million Passenger Miles[23, 4]	Injuries / 100 million Passenger Miles [24, 25]
Private Vehicle	289.8	1.5	91
Bus	48.2	0.5	66
Heavy Rail	0.5	0.22	5
Light Rail	39.0	0.96	27
Commuter Rail	0.9	0.45	14

Table 8 – Crash, Fatality and Injury Rates by mode per 100,000,000 passenger miles

Table 8 reveals that transit modes have significantly lower crash, fatality, and injury rates than travel by private vehicle. This suggests that there are significant safety benefits in shifting travel from private vehicle to transit. A recent report commissioned by the Automobile Association of America estimates that the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170 in 2005 dollars.[26]

As part of the requested analysis of the costs and benefits of regional transit investment, the TPB staff will quantify a range of the safety benefits to the region as a result of modal shifts due to Concept 3.

Methodology

The Atlanta Regional Commission staff undertook an effort to model Concept 3. This was a base model update, which only changed the transit network for the year 2030 and held all population, employment,

[21] Envision6, "Appendix G: *Envision6* Project Prioritization Technical Analysis" (Atlanta Regional Commission, Atlanta, GA 2008). Pg. G-22 – G25.

[22] Envision6, "Appendix G: *Envision6* Project Prioritization Technical Analysis" (Atlanta Regional Commission, Atlanta, GA 2008). Pg. G-24.

[23] Transit Safety & Security Statistics & Analysis 2003 Annual Report Federal Transit Administration. December, 2006. Pg. 78

[24] Report on Injuries in America. "Selected Measures of Unintentional Injuries, U.S., 2001-2005" (National Safety Council, Washington, D.C.) (www.nsc.org/library/report_table_2.htm) Last Accessed: December 27, 2007

[25] Transit Safety & Security Statistics & Analysis 2003 Annual Report Federal Transit Administration. December, 2006. Pg. 80

[26] Cambridge Systematics, Inc and Michael D. Meyer, Crashes vs. Congestion – What's the Cost to Society (Bethseda, MD, March 5, 2008).

and roadway networks the same as the adopted 2030 Envision6 model. This allowed a direct comparison of changes to travel behavior solely as a result of transit infrastructure improvements. To provide a range of the benefits from safety improvements, two approaches were used. One approach was similar to the ARC E6 approach in examining the reduction of total crashes that were forecast. The other approach examined only the forecast reduction in fatalities and injuries from the modal shift to transit. The basic approach for each method is the same.

To forecast the number of potential crashes, fatalities, or injuries by mode using the rates from table 2, the Equation 3 was used:

Equation 3: $CT_{ij} = PM_i * CR_j$

where:

i = Mode

j = Crash type (crash only, injury or fatality)

PM = Estimated Annual Passenger Mikes

CR = Crash rate / 100,000,000 passenger miles

CT = Total number of crashes for mode and type

Since the crash rates are specific to each travel mode, total crashes / fatalities or injuries from transit travel were estimated by summing the modal specific results using Equation 4:

Equation 4: $TTCj = \sum CT_{ij}$

where:

i = Mode

j = Crash type (crash only, injury or fatality)

CT = Total number of crashes for mode and type

TTC = Total for of crashes all modes

In order to compare the difference between estimated crashes, fatalities, or injuries resulting from a modal shift to transit, it was necessary to estimate the number of crashes, fatalities, or injuries that would have occurred if these trips used another mode. Several assumptions to estimate vehicle miles are used. First it was assumed that trips that utilize one of the transit modes would take place regardless of what mode they utilized since the model choice split in the ARC model takes place after the trip assignment process. Second each of these trips would take place using a motorized mode since the shortest average trip length by mode used to estimated transit passenger miles was 4.03 miles. Third, each of the replaced transit trips would be replaced with a trip in a private auto, either SOV, HOV2, HOV3+, etc. All passenger miles taken by transit trips could be estimated as taking place in private vehicles if there was no transit system. Estimated crashes, injuries or fatalities if all transit trips were shifted to the private auto are calculated with the Equations 5 and 6:

Equation 5: $EVM = (\sum PM_i) * VO$

where:

EVM = Estimated vehicle miles traveled

PM = Estimated annual passenger Miles

VO = Vehicle Occupancy Rate

i = Mode

Equation 6: $TC_{auto\ j} = EVM * CR_j$

where:

j = Crash type (crash only, injury or fatality)

EVM = Estimated Annual Vehicle Miles

CR = Crash rate / 100,000,000 vehicle miles

TC = Estimated number of crashes if trips switched to auto

In order to estimate the number of avoided crashes, fatalities, or injuries Equation 7 is used:

Equation 7: $AC_j = TC_{auto\ j} - TTC_j$

where:

AC_j = Estimated avoided crashes

TC_{auto} = Estimated number of crashes if trips switch to auto

TTC = Total estimated number of transit crashes

Equation 8 is used to estimate the value of avoided crashes, fatalities, or injuries:

Equation 8: $Value = AC_j * V_j$

where:

AC_j = Estimated avoided crashes

Vj= Estimated value of crash, fatality or injury

Value = Estimated value of all avoided crashes, fatalities, or injuries by mode shift to transit

The Automobile Association of America estimates that the average cost of a fatality is $3,246,192 and the average cost of an injury is $68,170 in 2005 dollars.[27]

[27] Cambridge Systematics, Inc and Michael D. Meyer, Crashes vs. Congestion – What's the Cost to Society (Bethseda, MD, March 5, 2008).

Table 9 below shows the results of applying this methodology to actual passenger miles traveled in the Atlanta region from 2000 – 2006.

Year	2000	2001	2002	2003	2004	2005	2006
Estimated Avoided Fatalities							
	9	10	10	10	10	10	11
Estimated Avoided Injuries							
	643	709	678	579	550	521	532
Estimated Value of Avoided Fatalities (Millions $)							
	$26.9	$30.4	$30.4	$28.9	$30.2	$31.7	$35.7
Estimated Value of Avoided Injuries (Millions $)							
	$38.5	$44.0	$42.5	$37.1	$36.3	$35.5	$37.3
Total Estimated Value of Avoided Injuries and Fatalities (Millions $)							
	$65.4	$74.4	$72.9	$66.0	$66.5	$67.2	$73.0

Table 9 – Historic Estimates of Value of Fatality and Injury Reduction by Existing Regional Transit System

Table 10 provides the estimated number of fatality and injury reduction by the Concept 3 regional transit system from the Regional Travel Demand Model results. The value of these potential reductions is presented in a following section.

	E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Estimated Avoided Fatalities						
	15	17	21	26	31	39
Estimated Avoided Injuries						
	750	990	1,250	1,550	1,900	2,400

Table 10 – Estimates of Value of Fatality and Injury Reduction by Regional Transit System

Table 10 reveals that a regional transit system similar to Concept 3 could potentially reduce fatalities and injuries on the Atlanta surface transportation network between 15 – 39 fatalities and reduce injuries between 990 and 2,400 annually based on a modal shift from roads to transit.

Create Mobility for commuters, elderly, the disabled, those without cars, those that do not drive, and visitors

This section examines how the Concept 3 network impacts mobility for a variety of markets. The previous sections have focused on accessibility for employment centers which is a primary focus on the commuter market. Therefore this section will focus on how the Concept 3 network impacts the elderly, the disabled, those without cars, and visitors to our region specifically examining how the accessibility of major hospitals, government centers, and regional parks. Tables 11 – 14 provide a list of major hospitals, courthouses, educational institutions, and major regional parks and entertainment venues, respectively, their current transit service and the transit service on the Concept 3 network.

Major Hospital	Current Transit Service	Concept 3 Service
Rockdale Hospital	N/A	Commuter Rail, Regional Suburban Bus
Columbia Eastside Medical Center	N/A	Regional Suburban Bus
Gwinnett Medical Center	GCT 40	Commuter Rail, Regional Suburban Bus, Arterial BRT
GHS – Joan Glancy Memorial	N/A	Commuter Rail, Arterial BRT
Crawford Long	MARTA North and Northeast lines, 23	Heavy Rail, Streetcar
Piedmont	MARTA 23	Beltline, Streetcar
North Fulton Regional	MARTA 185	Arterial BRT
Northside	MARTA North Line	Heavy Rail
Scottish Right	MARTA North Line	Heavy Rail
Saint Joseph's	MARTA North Line	Heavy Rail
Georgia Baptist	MARTA 99, 16	Local Bus
Hughes Spalding	MARTA East Line	Heavy Rail, Streetcar
Grady	MARTA East Line	Heavy Rail, Streetcar
South Fulton Medical Center	MARTA 55, 78, 93, 178	Local Bus
Fayette Community Hospital	N/A	Arterial BRT, Regional Suburban Bus
Promina Douglas	N/A	Regional Suburban Bus
Columbia Parkway Medical Center	N/A	Regional Suburban Bus
Emory Dunwoody Medical Center	MARTA 103	Local Bus
Veterans Hospital	MARTA 19	Commuter Rail, LRT
Emory University Hospital	MARTA 6, 245, 36	Commuter Rail, LRT
Wesley Woods Geriatric	MARTA 6, 245, 36	Commuter Rail, LRT
DeKalb Medical Center	MARTA 36, 123, 125	Local Bus
Egleston Children's Hospital	MARTA 6, 245, 36	Commuter Rail, LRT
Wellstar Kennestone Hospital	CCT 40, 45	LRT
Emory Adventist	CCT 20	Local Bus
Wellstar Cobb Hospital	CCT 30, 70	Arterial BRT, Regional Suburban Bus
Southern Regional Medical Center	C-TRAN 503	Regional Suburban Bus
Northside Cherokee Hospital - Canton	CATS 1	Regional Suburban Bus

Table 11 – Major Regional Hospital Transit Access

Major Educational Institutions	Current Transit Service	Concept 3 Service
Reinhardt College – Waleska	N/A	Regional Suburban Bus
Clayton College and State University	C-TRAN 501, 502	Commuter Rail
Kennesaw State University	CCT 40, 45	LRT, Freeway BRT
Southern Polytechnic State University	CCT 10, 101, 10C	LRT
Chattahoochee Tech	CCT 20	Arterial BRT
Life College	CCT 10	LRT
Georgia Perimeter – North	MARTA 132	Local Bus
Georgia Perimeter College South	MARTA 15	Arterial BRT
Georgia Perimeter College – Central	MARTA 121, 122, 125	Arterial BRT
Mercer University	MARTA 126	Local Bus
Oglethorpe University	MARTA 25	Local Bus
Emory University	MARTA 6, 36, 245	Commuter Rail, LRT
DeKalb Tech	MARTA 121, 122, 125	Arterial BRT\
Agnes Scott College	Decatur station	Heavy Rail
Emory University West Campus	MARTA 16	Arterial BRT
DeVry University	MARTA East Line	Heavy Rail
Mercer University – Douglas	N/A	Regional Suburban Bus
Carroll Tech – Douglas	N/A	Freeway BRT
Atlanta Metropolitan College	MARTA 95	Local Bus
Georgia Institute of Technology	MARTA North, Northeast, 113, Tech Trolley	Heavy Rail, LRT/Streetcar
Georgia State University	All MARTA Heavy Rail	Heavy Rail, Commuter Rail, Streetcar
Atlanta University Center	MARTA East, North, Northeast, Local Bus	Heavy Rail
Atlanta Christian College	MARTA 162	Local Bus
Georgia Gwinnett University	N/A	Regional Suburban Bus
Rockdale Center for Higher Education	N/A	Commuter Rail
Griffin Tech	N/A	Commuter Rail
Mercer University – College of Griffin	N/A	Commuter Rail
University of Georgia – Griffin	N/A	Commuter Rail
University of Georgia	Athens Transit	Commuter Rail

Table 12 – Major Regional Hospital Transit Access

Courthouses	Current Transit Service	Concept 3 Service
Cherokee County Courthouse	CATS 1, 2	Regional Suburban Bus
Clayton County Courthouse	C-TRAN 502	Commuter Rail, Arterial BRT, Regional Suburban Bus
Clayton County Justice Center	CTRAN 501, 504, Xpress 440, 441	Arterial BRT, Regional Suburban Bus
Cobb County Courthouse and Probate	CCT 15, 40, 45, 65	Arterial BRT
Cobb County Juvenile Courts	CCT 15	Local Bus
DeKalb County Juvenile Courthouse	MARTA 121	Arterial BRT
DeKalb County Courthouse	MARTA East Line	Heavy Rail
Douglas County Courthouse	N/A	Regional Suburban
Fayette County Juvenile Court	N/A	Arterial BRT, Regional Suburban Bus
Fayette County Courthouse	N/A	Arterial BRT, Regional BRT
Georgia Supreme Court	MARTA Heavy Rail	Heavy Rail, Arterial BRT
Fulton County Juvenile Court	MARTA Heavy Rail	Heavy Rail
Fulton County Probate Court	MARTA Heavy Rail	Heavy Rail
Georgia Court of Appeals	MARTA Heavy Rail	Heavy Rail, Arterial BRT
Fulton County Courthouse	MARTA Heavy Rail	Heavy Rail
Gwinnett County Courthouse	GCT 40	Commuter Rail
Henry County Magistrate	N/A	Freeway BRT, Regional Suburban Bus
Henry County Juvenile Court	N/A	Freeway BRT, Regional Suburban Bus
Henry County Probate Court	N/A	Freeway BRT, Regional Suburban Bus
Henry County Courthouse	N/A	Freeway BRT, Regional Suburban Bus
Rockdale County Courthouse	N/A	Commuter Rail, Regional Suburban Bus
Spalding County Courthouse	N/A	Commuter Rail, Arterial BRT
Spalding County Juvenile Court	N/A	Commuter Rail, Arterial BRT

Table 13 – Courthouse Transit Access

Major Parks / Entertainment Venues	Current Transit Service	Concept 3 Service
Sweetwater Creek Park	N/A	Regional Suburban Bus, Freeway BRT
Stone Mountain Park	MARTA 120, 118	Arterial BRT, Commuter Rail
Kennesaw National Battlefield	CCT 45	LRT
Chattahoochee National Recreational Area	MARTA 12, 85 CCT 10	LRT, Arterial BRT, Regional Suburban Bus
Piedmont Park	MARTA North, Northeast, 27, 26, 45	Heavy Rail, Streetcar, Beltline
Mount Arabia	N/A	Regional Suburban Bus
Panola Mountain Park	N/A	Regional Suburban Bus, Arterial BRT
Cochran Mill Park	N/A	Arterial BRT
Lake Allatoona Water Management Area	N/A	Regional Suburban Bus, Freeway BRT
Gwinnett Arena	GCT 103A, 50	Arterial BRT, LRT
Grant Park	MARTA 32, 97, 397	Beltline
Cobb Energy Center	CCT 10, 10B, 50	LRT
Spivey Hall	C-TRAN 501, 502	Commuter Rail
Memorial Arts Center	MARTA North, Northeast, 23, 36, 110, 110 CCT 10, GCT 412	Heavy Rail, LRT, Streetcar
Fox Theater	MARTA North, Northeast, 2, 27, 99, 110	Heavy Rail, Streetcar
Atlanta Civic Center	MARTA North, Northeast, 16	Heavy Rail
Philips Arena	MARTA West, PC	Heavy Rail, Commuter Rail, LRT, Streetcar
Chastain Park	MARTA 38	Local Bus
Encore (Alpharetta)	MARTA 140	LRT, Arterial BRT
Georgia Dome	MARTA West, PC	Heavy Rail, Commuter Rail, LRT, Streetcar
Alexander Memorial Coliseum	MARTA North, Northeast, 12, 37, 137	Heavy Rail
Ferst Center	MARTA 113, Tech Trolley	LRT
AUC Stadium	MARTA West, PC	Heavy Rail

Table 14 – Major Regional Park and Entertainment Venues Transit Access

Tables 11– 14 reveal that out of major destinations that the elderly, the disabled, people without cars, and visitors may want or have to travel to such as hospitals, courthouses, educational facilities, or entertainment venues, are reachable by transit with the Concept 3 network.

Cost Benefit and Effectiveness

This section presents efforts to quantify four major benefit areas and compare the benefits with the estimated cost of constructing, operating, and maintaining our existing transit system and Concept 3 network. The four areas of benefit are congestion cost, safety through reduction in fatalities and injuries, economic benefits through labor mobility, and potential consumer savings through fuel purchase avoidance.

Congestion Cost

Every year the Texas Transportation Institute publishes an annual report on urban mobility. The Atlanta region frequently focuses on the report's ranking of congestion cost and Travel Time Index. The Atlanta region has even adopted a goal of congestion tied to TTI targets. One frequently overlooked part of the report is the calculation of the travel time savings of the public transit system. Table 15 below provides the figures for the savings in terms of avoided congestion costs provided by the Atlanta region's transit network

Year	2000	2001	2002	2003	2004	2005	Total (2000 - 2005)
Estimated Value of Congestion Relief Provided by the Atlanta Regional Transit System[28]							
	$174,200,000	$202,100,000	$207,600,000	$214,300,000	$237,100,000	$245,200,000	$1,280,500,000
Total Transit Trips[29]							
	169,831,503	166,845,466	167,176,274	147,949,556	142,411,530	149,671,070	943,885,399
Average Congestion Benefit / Transit Trip							
	$1.03	$1.21	$1.24	$1.45	$1.66	$1.64	$1.37

Table 15 – Estimated Value of Congestion Relief Provided by the Regional Atlanta Transit System

Table 15 reveals that transit provides a significant amount of congestion relief to the Atlanta region. There are several potential methods for estimating the future benefit of congestion relief to the Atlanta region. This analysis uses the historic average value of congestion relief per trip provided to estimate the future benefits of congestion relief to the Atlanta Region. Between 2000 and 2005, the average congestion benefit is $1.37 / passenger trip. Using this average and assuming that this average holds for the future, it is possible to provide a rough estimate of the congestion benefits that occur with a regional transit system investment. Table 16 below provides an estimate using this method for the Atlanta region in 2030 with the E6 network and the Concept 3 network with the various population and employment shifts by the Atlanta Regional Commission.

[28] "Performance Measures Summary for Atlanta," 2007 Urban Mobility Report (College Station, TX). http://mobility.tamu.edu/ums/congestion_data/tables/atlanta.pdf (last accessed: May 15, 2008)
[29] "Update on Atlanta Regional Transit System Performance," Transit Planning Board (April 2, 2008) http://www.tpb.ga.gov/Documents/PM/040208%20-%20Update%20Existing%20Conditions%20Presentation.pdf (Last Accessed: June 17, 2008)

E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Estimated Annual Passenger Trips (Millions of Trips)					
213	248	303	365	436	536
Estimated Potential Annual Value of Congestion Relief (Millions $2005)					
$292	$340	$416	$501	$598	$736

Table 16 – Initial Estimate of Potential Range of Annual Value of Congestion Relief

Using the information provided by the regional travel demand model and the historic average value of congestion relief for Atlanta region, Table16 shows that Concept 3 could provide an annual value of between $340 to $736 million annually in 2005 dollars in 2030. This range is dependent on shifts in land use patterns.

Safety

Table 10 provided the estimated number of fatality and injury reduction by the Concept 3 regional transit system from the Regional Travel Demand Model results. Table 17 below presents the value of those fatality and injury reductions based upon an anticipated cost of fatalities and injuries.

E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Estimated Avoided Fatalities					
15	17	21	26	31	39
Estimated Avoided Injuries					
752	990	1,253	1,554	1,899	2,394
Estimated Value of Avoided Fatalities (Millions $)					
$47.6	$53.4	$66.9	$82.7	$100.5	$125.8
Estimated Value of Avoided Injuries (Millions $)					
$51.2	$67.5	$85.4	$105.9	$129.5	$163.2
Total Estimated Value of Avoided Injuries and Fatalities (Millions $)					
$98.8	$120.9	$152.3	$188.6	$230.0	$289.0

Table 17 – Estimates of Value of Fatality and Injury Reduction by Regional Transit System

Table 17 reveals that a regional transit system similar to Concept 3 could be expect to provide annual savings of between $121 - $289 million annually in 2030 in 2005 dollars due to reductions in fatalities and injuries due to the modal shift.

Economic Benefit

As noted, the Georgia Economic Modeling Systems report on the impact of the MARTA system on metro-Atlanta, the greatest benefit of the regional transit system is the unification of the labor market. This report estimates that the impact of the MARTA system on metropolitan Atlanta ranges between $2 - $2.5 billion annually between 2001 and 2006. To estimate a potential future benefit due to labor market unification. Table 18 below illustrates the average economic benefit per transit passenger mile from 2001 to 2006 in the Atlanta region.[30]

	2001	2002	2003	2004	2005	2006
Estimated Economic Impact of MARTA[31] (Millions $)						
	$1,333	$1,563	$1,571	$1,543	$1,589	$1,630
Total Annual Passenger Miles [32]						
	874,432,746	878,117,600	779,722,651	802,528,299	811,487,324	889,136,973
Estimated Economic Impact / Passenger Mile						
	$2.29	$2.73	$3.11	$2.90	$3.07	$2.88

Table 18 – Historic Estimated Economic Impact per Passenger Mile

Table 18 reveals that the range of the estimated economic impact per passenger mile of the regional transit system is between $2.29 and $3.11 with an average of $2.83 per passenger mile. Table 19 below reveals the estimate economic impact of the Concept 3 transit network using equation 2 to estimate passenger miles.

E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Estimated Passenger Miles (millions of miles)					
1,339	1,589	1,974	2,421	2,927	3,643
Estimated Value of Economic Impact (Millions $)					
$3,790	$4,500	$5,590	$6,850	$8,290	$10,300

Table 19 – Estimated Economic Impact per Passenger Mile

Table 19 reveals that the estimate economic impact of a regional transit network could be extremely significant ranging from $4.5 to $10.3 billion for the Atlanta region.

Potential Consumer Fuel Savings

With the recent increase in fuel prices there is increased interest in fuel savings. Using the estimated passenger miles with information regarding fleet fuel efficiencies, fuel prices, and average vehicle

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[30] Passenger miles were selected since the main impact of the benefit is from labor market unification meaning that that value of the distance traveled has a relationship with the benefit. For example, using a per trip basis would value a trip between the CBD and Midtown equally with a trip between the CBD and Douglasville, while a per passenger mile basis would capture the variation that the trip from Douglasville has more of an effect on incorporating Douglasville into the CBD's labor market pool.

[31] Tanner, Thomas C. and Adams Jones. <u>The Economic Impact of the Metropolitan Atlanta Rapid Transit Authority: An analysis of the impact of MARTA Operations on and around the service delivery region</u>. Georgia Economic Modeling System, Carl Vinson Institute of Government, The University of Georgia. Athens, GA. May, 2007.

[32] Source: NTD 2006 for MARTA, GRTA, CCT, GCT, City of Canton compiled by the Transit Planning Board

occupancy, it is possible to roughly estimate potential consumer fuel savings. Equation 9 presents the equation used to estimate potential consumer fuel savings[33].

Equation 9: *Value of Potential Consumer Fuel Savings = ((PM * VOR) / AFF) * PPG*
where:
PM = Estimated passenger miles
VOR = Vehicle Occupancy Rate
AFF = Average Fleet Efficiencies
PPG = Price per Gallon of Fuel

Table 20 presents the potential consumer fuel savings from a major transit investment.

	E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Estimated Passenger Miles (million of miles)						
	1,339	1,589	1,974	2,421	2,927	3,643
Estimated Vehicle Miles Traveled (millions of miles)[34]						
	1,100	1,300	1,620	1,980	2,400	2,990
Estimated Gallons of Fuel Saved (millions)[35]						
	65	77	95	117	141	176
Estimated Value of Potential Fuel Savings (millions $)[36]						
	$261	$310	$385	$472	$571	$711

Table 20 – Estimated Consumer Fuel Savings

Table 20 reveals that, potentially, consumer fuel savings could be in the range of $310 to $711 million annually from an investment in transit infrastructure.

Incorporation of Cost Benefit Information

The Board has indicated that an analysis of cost/benefit information is of interest. Additional focus in the region has been placed on estimating congestion relief benefit and nationally on the incorporation of safety benefits. Additionally, other research has revealed that a significant benefit of transit is the unification of the labor market in Atlanta and there has been growing interest in fuel savings as a result of recent price increases. Therefore, benefits quantified as part of this assessment of Concept 3

[33] This equation assumes that all trips not taken by transit would still be taken and that they would be taken by private vehicle. The ARC model does not currently have modal choice values for pedestrian or bicycles and therefore, removing transit modes from the model would shift personal transit trips to vehicle trips. Further work would need to be done to estimate the number of trips that would not be taken as a result of removing transit mode choices.
[34] Estimated Atlanta Vehicle Occupancy Rate = 1.22 passengers / vehicle. Gilbert, Richard. "Greater Toronto Area Comparisons." Toronto, ON. May 30, 2003.
[35] Average Atlanta Fleet Efficiency = 17 miles/gallon. Atlanta Regional Commission. Transportation Spotlight. Atlanta, GA. June 2, 2008.
[36] Average Atlanta Fuel Price = $4.048. "Atlanta gas prices hit record high," Atlanta Journal Constitution. July 5, 2008. (http://www.ajc.com/metro/content/metro/stories/2008/07/05/gas_0706.html Last accessed: July 17, 2008).

network on Atlanta's transportation infrastructure include estimates of congestion savings, safety savings, economic, and consumer fuel savings. Table 21 below projects these results out into the future using the results of the regional Travel Demand Model and compares these benefits with the estimated annual cost of Concept 3. An annual number in the horizon year of 2030 is used since a phasing plan for Concept 3 was not assumed at this time.

	E6	Concept 3 – No Pop/ Emp. Shift	Concept 3 – 5% Pop/ Emp. Shift	Concept 3 – 10% Pop/ Emp. Shift	Concept 3 – 15% Pop/ Emp. Shift	Concept 3 – 20% Pop/ Emp. Shift
Total Estimated Value of Avoided Injuries and Fatalities (Millions $)						
	$98.8	$120.9	$152.3	$188.6	$230.0	$289.0
Estimated Potential Annual Value of Congestion Relief (Millions $)						
	$292	$340	$416	$501	$598	$736
Estimated Economic Benefit (Millions $)						
	$3,790	$4,500	$5,590	$6,850	$8,290	$10,300
Estimate Consumer Benefits from Fuel Savings (Millions $)						
	$261	$310	$385	$472	$571	$711
Total Estimated Value of Benefits (Millions $)						
	$4,440	**$5,270**	**$6,540**	**$8,010**	**$9,690**	**$12,000**

Table 21– Estimates of Value of Fatality and Injury Reduction by Regional Transit System

Table 21 reveals that direct congestion and safety benefits from a regional transit system similar to Concept 3 could range from $5,270 to $12,000 million annually depending upon shifts in population and employment patterns. Previous work estimated that the Concept 3 network, including operation and maintenance of the existing transit network, would cost approximately $2.4 billion annually meaning that in 2030 the ratio of annual benefits to cost could be estimated at between 2.2 to 5.0.

Effectiveness:

In an effort to examine whether the proposed projects were within the national norms of effective systems, the different components of the Heavy Rail and Light Rail extensions were compared on a boardings per mile basis with recent new start systems in the U.S. Figure 13 presents different segments of the Concept 3 systems compared with national systems.

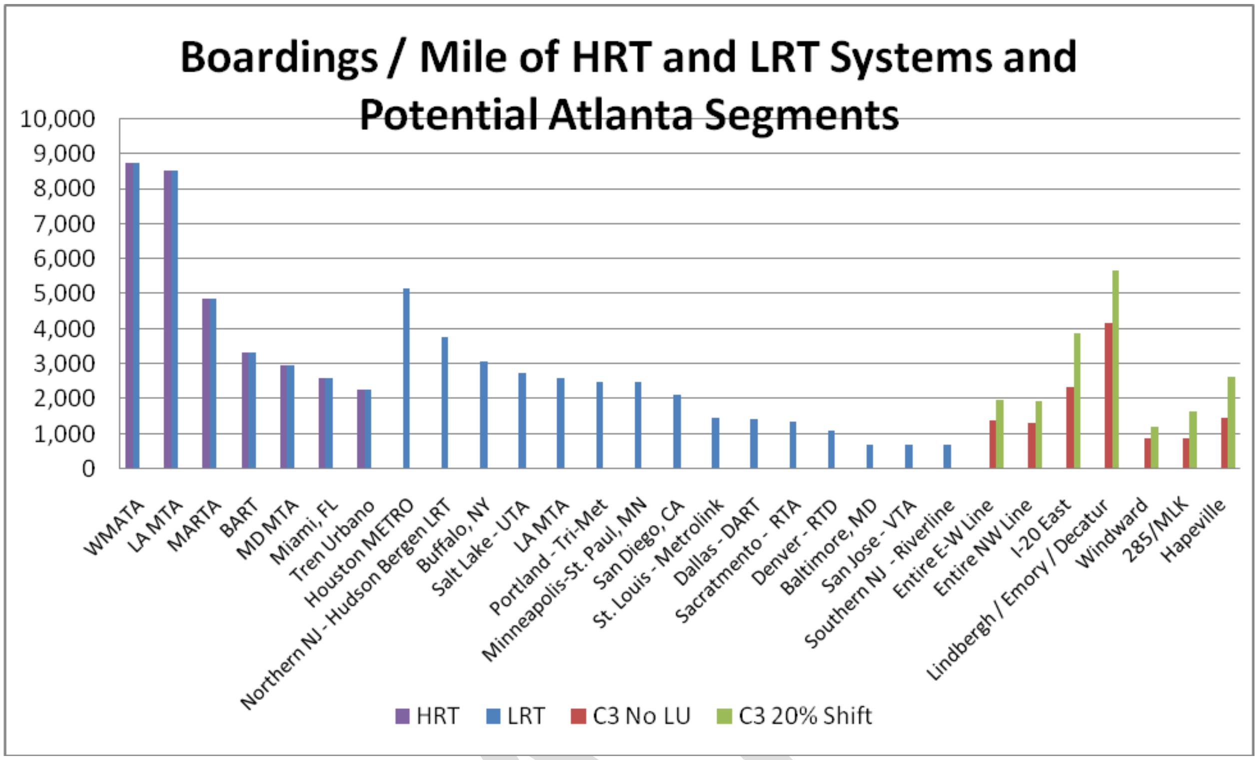

Figure 13 – Concept 3 HRT and LRT Segments compared with New U.S. Systems

Figure 13 reveals the different segments of the LRT/Streetcar network on the Concept 3 network generally fall within the range of new U.S. LRT systems. Additionally, the I-20 East busway boardings per mile number also falls within the range of the new LRT systems. The HRT extensions fall within the range of LRT systems, but generally below the range of new HRT systems in the U.S. since the opening of BART in San Francisco.

This examination suggests that some shift in technology on some of the potential extensions. These potential changes are discussed in the associated report “Initial Report on Proposed Changes to the Concept Network” produced for the July 24, 2008 TPB Committee meetings.

Land Use Synergies

Livable Centers Initiative Area	Current Transit Service	Concept 3 Service
Acworth	Express Bus	Freeway BRT, Regional Suburban Bus
Austell	N/A	Commuter Rail
Avondale	Heavy Rail, Local Bus	Heavy Rail, Commuter Rail
Bankhead Station	Heavy Rail, Local Bus	Heavy Rail
Bolton – Moores Mill	Local Bus	Streetcar
Brookhaven MARTA Station	Heavy Rail, Local Bus	Heavy Rail
Buckhead	Heavy Rail, Local Bus	Heavy Rail, Commuter Rail
Buford	Local Bus, Express Bus	Commuter Rail, Regional Suburban Bus
Canton	Local Bus, Express Bus	Regional Suburban Bus, LRT
Chamblee	Heavy Rail, Local Bus	Heavy Rail
Chattahoochee Hill Country	N/A	Regional Suburban Bus
City Center	Heavy Rail, Local Bus, Express Bus	Heavy Rail, Commuter Rail, Streetcar
Clarkston		
Conyers	Express Bus	Commuter Rail, Regional Suburban Bus
Cumberland		LRT
Decatur	Heavy Rail, Local Bus	Heavy Rail
Dell Road TOD	Local Bus	LRT
Doraville	Heavy Rail, Local Bus	Heavy Rail, Commuter Rail
Douglasville	Express Bus	Commuter Rail, Regional Suburban Bus
Duluth	Express Bus, Local Bus	Commuter Rail, Arterial BRT, Regional Suburban Bus
East Point	Heavy Rail, Local Bus	Heavy Rail, Commuter Rail
Emory Village	Local Bus	Commuter Rail, LRT
Fayetteville	N/A	Arterial BRT, Regional Suburban Bus
Forest Park	Local Bus	Commuter Rail
Greenbriar	Local Bus	Arterial BRT
Griffin	N/A	Commuter Rail, Arterial BRT
Gwinnett Place	Local Bus	LRT, Arterial BRT
H.E. Holmes	Heavy Rail, Local Bus	Heavy Rail, Arterial BRT
Hapeville	Local Bus	Heavy Rail
Hapeville / Virginia Avenue	Local Bus	Heavy Rail
Highway 278	N/A	Commuter Rail
Holly Springs	N/A	Regional Suburban Bus
Hwy 78	Express Bus	Arterial BRT
Indian Trail – Lilburn	Local Bus	Commuter Rail
Jonesboro	Local Bus, Express Bus	Commuter Rail, Arterial BRT, Regional Suburban Bus
JSA-McGill	Heavy Rail, Local Bus, Express Bus	Heavy Rail

Kennesaw	Local Bus, Express Bus	LRT, Freeway BRT
Kensington MARTA Station	Heavy Rail, Local Bus	Heavy Rail, Arterial BRT
Lilburn	N/A	Commuter Rail
Lithonia	Local Bus, Express Bus	Commuter Rail, LRT
Mableton	Local Bus, Express Bus	Commuter Rail
Marietta	Local Bus, Express Bus	LRT
McDonough	Express Bus	Freeway BRT, Regional Suburban Bus
Memorial Drive – MLK Station		Heavy Rail, Arterial BRT
Midtown	Heavy Rail, Local Bus, Express Bus	Heavy Rail, LRT, Streetcar
Morrow	Local Bus	Commuter Rail
Norcross	Local Bus	Commuter Rail, LRT, Regional Suburban Bus
Northlake	Local Bus	Freeway BRT
Northwest Clayton	N/A	Regional Suburban Bus
Oakland City –Lakewood	Heavy Rail, Local Bus	Heavy Rail
Old National Highway	Local Bus	
Peachtree City	N/A	Commuter Rail, Arterial BRT
Perimeter Center	Heavy Rail, Local Bus, Express Bus	Heavy Rail, LRT
Powder Springs	Express Bus	Regional Suburban Bus
Riverdale Town Center	Local Bus	Arterial BRT, Regional Suburban Bus
Roswell	Local Bus	Arterial BRT
Sandtown	N/A	Arterial BRT, Regional Suburban Bus
Sandy Springs	Local Bus	LRT, Arterial BRT
Smyrna	Local Bus	LRT
Snellville	Express Bus	Regional Suburban Bus
Stockbridge	Express Bus	Freeway BRT, Regional Suburban Bus
Stone Mountain	Local Bus	Commuter Rail, Arterial BRT
Suwannee	N/A	Commuter Rail
Town Center Area	Local Bus, Express Bus	LRT, Regional Suburban Bus
Tucker	Local Bus	Commuter Rail, Regional Suburban Bus
Union City	Local Bus, Express Bus	Commuter Rail
Upper Westside		
West End	Heavy Rail, Local Bus	Heavy Rail, Streetcar
West Lake MARTA Station	Heavy Rail, Local Bus	Heavy Rail
Woodstock	Express Bus	Regional Suburban BUs

Table 22 – LCI Study Areas and Transit Access

Table 22 reveals that there are several different LCI areas that have either no transit service or only peak hour service but that the Concept 3 network would provide these areas with transit service. Since one of the goals of many of the LCI initiatives is to support pedestrian environments and infrastructure, providing transit services to areas investing pedestrian infrastructure should enable the transit service to attract more riders as well as reinforcing the investments by local governments in pedestrian infrastructure.

Conclusions

The final points from this initial analysis of the impact of a regional transit system similar to Concept 3 on the Atlanta region are:

1. An estimated daily weekday ridership between 832,000 and 1,800,000
2. Increased accessibility to the major employment centers
3. Estimated value of annual congestion mitigation benefits between $340 and $736 million
4. Estimated 15 to 40 fewer annual highway fatalities
5. Estimated annual benefits in 2030 between $5.3 -$12 billion
6. A potential ratio of estimated annual benefits to estimated cost of Concept 3 between 2,2 and 5.0
7. Increased accessibility to major hospitals, courthouses, educational facilities, regional parks, and entertainment venues

Appendix 1: Changes to the ARC Envision6 Model

This appendix provides an overview of the travel demand modeling work that serves as an important component of the technical analysis completed for Concept 3. This work includes a scenario-based modeling exercise devised specifically for the Concept 3 analysis, in which significant changes were made to the underlying socioeconomic data to allow for more transit-intensive land use scenarios.

ARC Travel Demand Model Background

The Atlanta Regional Commission travel demand model is designed to, at a minimum; represent the state of the practice in travel demand modeling and to meet all modeling requirements in the US EPA Transportation Conformity Rule. All elements of the travel demand model are designed to support all technical and policy decisions that are required in developing a comprehensive, multimodal transportation plan and program.

Several data inputs are essential to the effectiveness of the model. In addition to the transportation network itself, a key input for the travel demand modeling process is detailed zone-level socioeconomic data for the 20-county Atlanta region, traditionally produced for future years with the use of a DRAM/EMPAL land use forecast model. Two files, a households file and land use / employment file, are used throughout the modeling process.

The households file quantifies the number of households in each traffic analysis zone (TAZ). To allow for a more robust trip generation process, the household data is broken down by two factors, household income and household size. Specifically, household data in the ARC model is broken down into four income groups, and within each group households are broken down into six size groups (i.e. each household has between one and six people). These subdivisions are all quantified to the TAZ level.

The land use file provides detailed information, also quantified to the TAZ level, on land use patterns within each zone, focusing specifically on employment activity. Like the household data, the land use data is also categorized to allow for more advanced trip generation and distribution. Specifically, the following activities are all quantified at the TAZ level:

- Construction Employment
- Manufacturing Employment
- TCU (Transportation, Communication, Utilities) Employment
- Wholesale Employment
- Retail Employment
- FIRE (Finance Insurance, and Real Estate) Employment
- Service Employment
- Government Employment
- University Enrollment

Initial Concept 3 Modeling Activities

The first application of the travel demand model to Concept 3 consisted of replacing the 2030 Envision6 transit network with the much more extensive Concept 3 network, while retaining the 2030 forecasts for zone-level population and employment data. While this “baseline” run showed significant increases in transit ridership as a result of the expanded network, the fact that the Envision6 socioeconomic data does not take into account the modified transit network inherently limits the degree of ridership growth estimated by the model.

Following the initial Concept 3 model run based on Envision 6 socioeconomic forecasts, it became evident that an opportunity exists to create a series of new socioeconomic inputs for the 2030 horizon year based on a geographic shift of households and jobs toward greater concentration around the expanded Concept 3 transit system. This realization led to a comprehensive scenario-based modeling effort that became an important component of the Concept 3 technical analysis.

Before reviewing the methods employed to model these hypothetical shifts, it must be emphasized that the results from any modifications to population and employment distribution reflect potential *scenarios*, but cannot be considered true *forecasts* since their development does not involve the level of statistical sophistication that is seen in the development of the original 2030 Envision forecast (based on DRAM/EMPAL and other complex forecasting tools). Still, the data do provide a useful, albeit simplified, look at how modified land use patterns can impact transit ridership and other relevant performance measures at the regional level.

Population/Employment Shift Methodology

A standardized process was developed to modify the existing socioeconomic data such that the goal of a geographic shift of population and/or employment toward a more transit-oriented pattern (while not affecting total regional population and employment levels) is achieved. This process can be broken down into the following steps:

1. Identify the donor and recipient zones

The first step is to analyze the existing TAZ's, classifying each into one of the following two categories:

- "Recipient" zones – TAZ's that will gain households and/or jobs in the horizon year (2030) relative to the Envision6 forecast. These are the zones that are best served by transit in under Concept 3.
- "Donor" zones – TAZ's that will lose households and/or jobs relative to 2030 Envision6 forecast (though they typically still gain households/jobs in relation to the 2005 baseline, but at a more modest growth rate).

For the Concept 3 scenario-based modeling exercise, separate techniques were devised to identify the donor and recipient zones for the household and employment shifts.

For households, zones whose geographic center lies within two miles of a Concept 3 service point are classified as a recipient zone. These service points include all existing and proposed rail stations as well as major bus transfer centers and park-and-ride lots. All remaining zones are classified as donor zones.

For the employment shift, a more limited recipient area is used, based on the activity centers defined in ARC's Unified Growth Policy Map (UGPM). Specifically, four categories of places defined in the UGPM are the focus of the employment shift: the center city (Downtown and Midtown Atlanta), regional centers (areas such as Buckhead, the airport, etc.), town centers (e.g. downtown Marietta), and station communities (e.g. Lindbergh Center – note that many higher-activity stations are already located in one of the other three place types). Any TAZ whose geographic center lies within the boundaries of a UGPM place is classified as a recipient zone, and all other areas are classified as donor zones.

2. Determine the shift factors for population and/or employment

The next step is to determine a percentage that represents the portion of total regional households/employment to be shifted from the "donor" zones to the "recipient" zones.

As a hypothetical example, suppose a region has a forecast horizon year population of 1,000,000 households. If a household shift factor of 10 percent is chosen, then household-shift scenario would consist of the region's donor area losing 100,000 households, with the region's recipient area gaining 100,000 residents. The total population of the region would remain unchanged at 1,000,000 households. A similar pattern would also be observed with an employment shift.

While it is possible to have different population and employment shift factors within a single scenario, for the purposes of the Concept 3 analysis exercise, the same shift factor was always applied to both population and employment within each scenario. Specifically, four separate scenarios were analyzed, with varying population/employment shifts of 5, 10, 15 and 20 percent.

3. Reduce household / employment totals in the donor zones

This step consists of calculating the total population of the donor zones and determining the overall decrease in population across all donor zones as a result of the shift. Then, the totals for each of these individual zones are reduced by this percentage.

Returning to the previous example of a 1,000,000-household region, suppose that the identified household donor zones (as selected in step 1) collectively comprise 400,000 residents. Since the chosen 10 percent shift involves moving 100,000 residents from the donor to the recipient zones, the end result is decrease of 25 percent (100,000 households shifted from the original 400,000) within the donor area. Therefore, to perform the donor side of the shift, the household total for each identified donor zone is individually reduced by 25 percent.

4. Distribute the households / employment to the recipient zones.

Finally, the households and jobs that were removed from the donor zones are redistributed to the recipient zones. In the case of both the household and employment shifts, the changes are applied such that the regional totals for the various categories of households (income group and household size) and jobs (economic sectors) remain constant. However, the specific method for the distribution differs between the population and employment shifts.

For the employment shift, the donor recipient zones represent a more limited area as defined be the UGPM place types (see Step 1). In the interest of reinforcing existing major employment centers, rather than distributing the shifted jobs equally to all TAZs, the distribution was instead weighted to favor the more intensive UGPM place categories (regional centers and city centers). Specifically, 40 percent of the shifted jobs were sent to regional center TAZs, 30 percent to the center city, 20 percent to town centers, and 10 percent to the comparatively small category of station communities.

For the population redistribution, households are distributed to the recipient zones without preference for any area of the region. Instead, the overall percentage increase for the recipient area is applied individually to each zone, similar to the reduction procedure in step 3.

It should finally be noted that some variation is seen in the final regional totals of population and, to a lesser extent, employment after the shifts are completed. This error is due to the nature of the fine-grained breakdown by zone, household size, income group, and employment type, resulting in many cases where the proportional adjustments result in the rounding of fractional amounts to the nearest integer value. Collectively, this rounding can have a noticeable effect on the resulting regional totals, but because this variation is generally within 1 to 2 percent of the original total it is considered tolerable for the purposes of this exercise.

Visualization of the Population and Employment Shift

Figures 1 and 2, below, illustrate the results of the population and employment changes for the 20 percent shift, the most dramatic change considered. The darker-shaded TAZ's represent greater concentrations of households (Figure 1) or jobs (Figure 2). The yellow points in Figure 1 represent the locations of stations under the full Concept 3 buildout, while the yellow outlines in Figure 2 represent the boundaries of the UGPM activity centers.

Figure 1 – Illustration of 20 Percent Population Shift

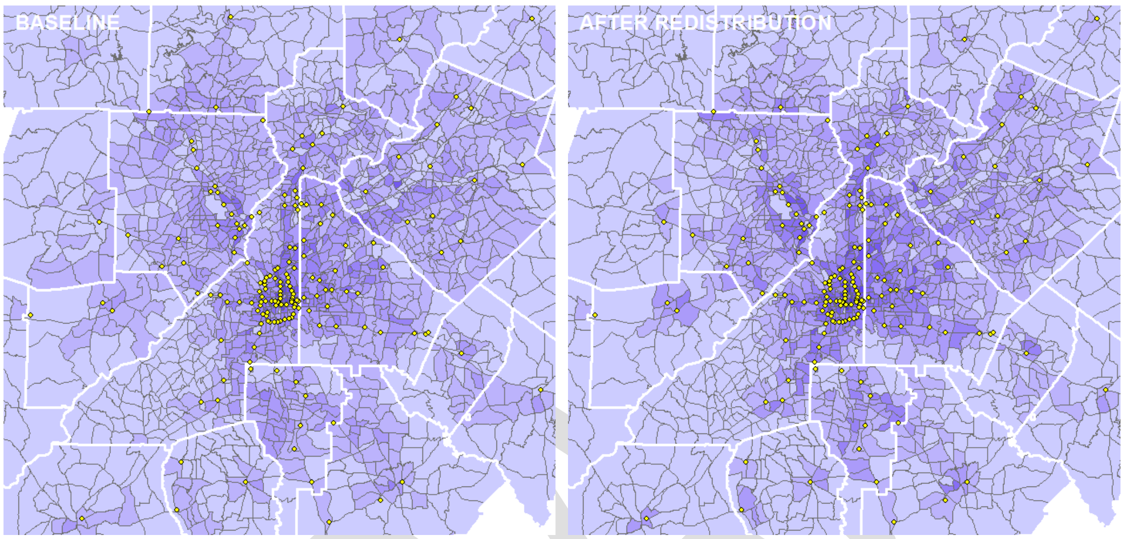

Figure 2 – Illustration of 20 Percent Employment Shift